NEWS.

# Lake Erie increasingly susceptible to large cyanobacteria blooms

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A Lake Erie algae bloom in September 2009. This photo was taken on the southeast shore of Pelee Island, Ontario. Image credit: Tom Archer

ANN ARBOR—Lake Erie has become increasingly susceptible to large blooms of toxin-producing cyanobacteria since 2002, potentially complicating efforts to rein in the problem in the wake of this year's Toledo drinking water crisis, according to a new study led by University of Michigan researchers.

Since the detection of the toxin microcystin left nearly half a million Ohio and Michigan residents without drinking water for several days in early August, discussions of ways to prevent a recurrence have largely focused on the need to reduce the amount of phosphorus fertilizer that washes off croplands and flows into western Lake Erie to trigger harmful cyanobacteria blooms.

In a study published online Oct. 8 in the journal Water Resources Research, scientists from U-M and the National Oceanic and Atmospheric Administration conclude that microcystin-producing cyanobacteria in Lake Erie are becoming more sensitive to phosphorus and that reductions may have to cut far deeper than recently proposed targets.

"Our results suggest that current phosphorus loading targets will be insufficient for reducing the intensity of cyanobacteria blooms to desired levels, so long as the lake remains in a heightened state of bloom susceptibility," said lead author Daniel Obenour, formerly of the U-M Water Center and now at North Carolina State University. Other authors are Don Scavia of U-M and Andrew Gronewold and Craig Stow of the National Oceanic and Atmospheric Administration.

The paper is a technical analysis of the uncertainties involved in computer modeling studies that use the amount of phosphorus entering Lake Erie in the spring to predict the size of late-summer cyanobacteria blooms, which have grown larger since the mid-1990s.

Though the total amount of phosphorus entering the lake seems to be the best predictor of bloom size, that variable alone doesn't fully explain the observed size increase during the study period examined by the team, 2002 to 2013.

The researchers used a computer model to determine whether rising levels of a special form of phosphorus called dissolved reactive phosphorus or DRP, which is more readily absorbed by algae, could explain the trend toward increased bloom susceptibility. It didn't.

They also looked at water temperatures in Lake Erie. In coming decades, warming waters are expected to exacerbate the lake's harmful algal bloom problem. But from 2002 to 2013, late-summer Lake Erie surface temperatures did not increase significantly, suggesting that some other factor is at work, according to the researchers.

One possibility is that the spread of invasive quagga and zebra mussels in the lake has promoted the dominance of microcystin-producing cyanobacteria and has altered the lake's phosphorus cycle. Recent U.S. Geological Survey studies in western Lake Erie suggest a decrease in zebra mussel numbers but an increase in quagga mussels and total mussel abundance over the last decade.

Quagga and zebra mussels shun toxin-producing Microcystis cyanobacteria and feed instead on other species of phytoplankton at the base of the lake's food chain, including algae.

"We tested to see if the increase in the DRP fraction could be the cause, and it did not pass the test. It also does not look like water temperature is driving the increased susceptibility. We're thinking it may have been the increase in mussels," said U-M aquatic ecologist Scavia, co-author of the study and director of the Graham Sustainability Institute.

Other potential explanations for the reported trend in bloom susceptibility are increasingly calm summer weather conditions, which can also promote cyanobacteria dominance, and a growing reservoir of Microcystis seed colonies at the bottom of Lake Erie.

Whatever the cause, the finding of increased susceptibility suggests that proposed management targets for reduced phosphorus loads in Lake Erie may not go far enough.

In February, the International Joint Commission called on the governments of the U.S. and Canada to adopt new targets for Lake Erie phosphorus levels to curtail harmful algal blooms. The IJC recommended that the total phosphorus target for Ohio's Maumee River, which drains agricultural land and empties into western Lake Erie, be cut 37 percent during the spring.

The IJC said those reductions would "reduce the frequency and severity of harmful algal blooms in the western Lake Erie basin to an acceptable level." But Obenour, Gronewold, Stow and Scavia conclude that because of the increased sensitivity of the Lake Erie system, even the ambitious reductions urged by IJC will likely be insufficient.

"As long as the lake remains in this heightened state of susceptibility, this problem is likely to persist. That means we need to better understand what is driving the increased susceptibility and whether it can be controlled, or if deeper phosphorus reductions are needed," Scavia said.

The Water Resources Research paper is titled "Using a Bayesian hierarchical model to improve Lake Erie cyanobacteria bloom forecasts." Gronewold and Stow are at NOAA's Great Lakes Environmental Research Laboratory in Ann Arbor.

The project was funded by the Great Lakes Restoration Initiative's SOAR (Synthesis, Observations and Response) Project, the U-M Water Center, the Cooperative Institute for Limnology and Ecosystems

Research and NOAA. The work is part of a partnership with NOAA's National Ocean Service and its ongoing collaborative work on understanding and forecasting harmful algal blooms.

**Related Link:**

- Water Resources Research is a journal of the American Geophysical Union.
  Abstract: http://onlinelibrary.wiley.com/enhanced/doi/10.1002/2014WR015616/

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